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ABSTRACT

Through identifying sources and interpreting findings from the fields of medical illustration, psychology, and education, the research described provides the teacher of medical illustration with a framework for promoting in students an active sense of their creative abilities. The need for the study, background information, limitations, and procedures are discussed in chapter 1. Following the review of literature in chapter 2, chapter 3 deals with findings from the literature of medical illustration and surveys the body of facts and opinions on the need for creative ability in illustrators. An overall performance objective, derived from the literature, is presented which states that the professional medical illustrator will demonstrate conceptualization, visualization and abstraction abilities, and will exhibit characteristics of flexibility and versatility in art techniques and adaptability to change in the medical environment. Chapter 4 deals with research findings on creativity: Definitions, steps in the creative process, and creativity in the scientific and artistic occupations. Teaching methods and techniques advocated by educational psychologists and methodologists for the growth of creative artistic production are discussed in chapter 5, and conclusions and recommendations are presented in chapter 6. A bibliography is appended. (SH)

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TEACHING METHODS FOR THE DEVELOPMENT OF CREATIVITY IN MEDICAL ILLUSTRATION

by

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THESIS

Presented to the Faculty of the Graduate School of Biomedical Sciences

The University of Texas Health Science Center at Dallas

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF ARTS

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TEACHING METHODS FOR THE DEVELOPMENT OF CREATIVITY

IN MEDICAL ILLUSTRATION

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Dedicated to the medical illustrators, past and present, who have created a tradition of excellence; and to my husband, Moore Anderson, and my parents, Dr. and Mrs. Philip J. Antrim, who understood my desire to undertake this study.

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Phyllis Antrim Anderson
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TEACHING METHODS FOR THE DEVELOPMENT OF CREATIVITY IN MEDICAL ILLUSTRATION

CHAPTER I

INTRODUCTION

The professional medical illustrator solves problems of conceptualization, visualization and abstraction of complex ideas in preparing instructional materials for medical education. These problems require that the medical artist have a broad knowledge of basic medical science, competence in illustration techniques, a professional attitude and creative ability. Teachers of medical illustration face the difficult question: How do we teach people technical skills and knowledge without inhibiting their creativity? The purpose of this thesis is to provide a framework for thinking about creativity as an aspect of medical illustration education. The aim is to bring fundamental ideas about creativity into conscious focus, so that they can be used with intention.

NEED FOR THE STUDY

The literature on medical and biological illustration stresses the importance of and the need for creativity. However, after reviewing over seventy journal articles and books listed in the Association of Medical Illustrators Cummulative Bibliography 1967, this writer finds that there are virtually no authors in the field of medical illustration who offer constructive suggestions on how creativity may be achieved. The nature of

creativity in medical illustration has been imperfectly understood, and therefore is a suitable subject for study.

Creativity is thought by some to be mysterious, spontaneous, and beyond the realm of scientific analysis and experimentation.[1] This idea persists despite the accumulation of a nearly unmanageable volume of literature by psychologists and other behavioral scientists on the topic of creativity since the 1950s, when a great surge of research was begun, with psychologist Joy Paul Guilford leading an outpouring of studies.[2] This research has resulted in findings which have implications for learning and teaching.

Artists and art teachers have recognized the value of creativity for a long time, and have devised methods and theories for cultivating creativity, but generally these approaches have been applied only in elementary and secondary education and have largely been ignored at the adult level. Information in the area of education should be applied to teaching more advanced art students. Through better understanding of the types of instruction which seem most productive of creativity, the stifling of

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[1]Frank Barron, "The Psychology of Imagination," Scientific American, Vol. 199, No. 2, Sept. 1958, p. 151, and Elliot W. Eisner, "Research on Teaching the Visual Arts," Second Handbook of Research on Teaching, Chicago, Rand McNally and Co., 1973, p. 1196.

[2]J. W. Getzels and J. T. Dillon, "The Nature of Giftedness and the Education of the Gifted," Second Handbook of Research on Teaching, Chicago, Rand McNally and Co., 1975, p. 692.

imagination may be avoided and a climate for stimulating creativeness can be developed.

The central problem is one of developing the necessary scientific, technical and professional skills without simultaneously inhibiting the capacity to think and act creatively. Jerome Weisner, Dean of the School of Science at Massachusetts Institute of Technology, quotes educational philosopher Alfred North Whitehead as saying:

> The key fact in education, and the reason for most of its difficulties is that necessary technical excellence can be acquired only by training which is apt to damage those energies of mind which should direct the technical skills.[3]

Our educational system too often produces conformity in thought and action rather than originality and innovative behavior. Students with vast knowledge and technical facility are not necessarily creative. Our educational processes can be geared to go beyond teaching mere rote and technical learning, and instruct the students how to use all of their creative resources.

Materials collected for this study are presented in the following sequence. After the review of literature in Chapter II, Chapter III deals with findings from the literature of medical illustration and will survey the body of facts and opinions on the need for creative ability in illustrators. Chapter IV deals with research findings on creativity: definitions, steps in the creative process, and creativity in the scientific and artistic occupations. Chapter V discusses teaching methods advocated by educational psychologists and methodologists for the growth of creative artistic production. Chapter VI deals with conclusions and recommendations.

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[3] Jerome Weisner, "Education for Creativity in Science," Daedalus, Summer 1965, Vol. 94, No. 3, pp. 527-537.

BACKGROUND

In recent years, theoretical and experimental work on creativity has become important to educational thought. However, little has been written on adult art education; perhaps this is because in higher education the subject matter content has been emphasized more than the means by which information is communicated. In fact, the area of educational psychology has been disregarded by some professors.[4] This situation is widespread and is not limited to the teaching of art. The "publish or perish" syndrome may in part be responsible for the lack of emphasis on the methods for teaching students in higher education.

HYPOTHESIS

The hypothesis of this study is that there presently exists enough knowledge and theory which when drawn together will aid the teacher of prospective medical illustrators in maintaining or reawakening in students an active, imaginative and lively use of their creative resources. The objective will be to identify sources and interpret findings from the following fields: medical illustration, psychology and education. This information will allow this researcher to arrive at conclusions about teaching strategies. Suggestions will be generated to aid instructors of medical illustration in promoting their students' creative potential.

LIMITATIONS

The thesis will be limited to finding and describing teaching methods for nurturing problem-solving abilities, innovative ideas and free and imaginative use of knowledge and skills in students. No attempt will be made to deal with such related topics as the selection of faculty members

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[4]Malcolm Knowles, The Adult Learner: A Neglected Species, Houston, Gulf Publishing Company, 1973, p. 40.

and students in medical illustration programs, or the curricula and philosophies of the specific schools. Nor will this study review the course content, the specialized techniques and media of medical illustration, or the inculcation of a professional attitude.

PROCEDURE

A survey has been made of the last ten years' literature, using the following research tools: Index Medicus, Art Index, Educational Resources Information Center (ERIC), Dissertation Abstracts, Association of Medical Illustrators Cummulative Bibliography 1967 (AMI), Psychological Abstracts, Sociological Abstracts, Social Science and Humanities Index, and the card catalogues of The University of Texas Health Science Center at Dallas (UTHSCD) Medical Library and the Southern Methodist University Library. These sources were reviewed for entries under several descriptors, such as: "creative development," "creativity research," "creative art," "creative ability," "creative thinking," "scientific illustration," "medical illustration," "art education," and "art education research." Information gained from conversations and correspondence with professors who have knowledge of the fields of medical illustration, education and psychology is included: Mr. Steven Harrison, Dr. Fred L. Christen, Dr. Arthur Babick, all of the Department of Biomedical Communications, UTHSCD; Dr. Ann McGee, of the Southern Methodist University Art Department; Dr. Maurice Korman, Department of Psychology, UTHSCD; Mr. Richard Meyers of the American Medical Association, Chicago; Dr. Donald Meichenbaum, University of Waterloo, Ontario, Canada; and Dr. E. Paul Torrance, University of Georgia.

SUMMARY

Keeping the profession of medical art vital, alive and growing

requires the creative capacity for generating problems and producing solutions. If the profession fails to grow, it will become mannered and academic or will decline. The challenge to medical artists is to generate fresh and creative solutions to problems. The eminent nuclear physicist, J. Robert Oppenheimer, says simply, "We need every good idea we can get."[5] This thesis will attempt to provide a few such "good ideas" for the nurturing of creativity during the training of medical illustrators.

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[5]J. Robert Oppenheimer, quoted by Buckminster Fuller, I Seem To Be A Verb, Bantam Books, 1970, p. 103.

CHAPTER II

REVIEW OF LITERATURE

This review of literature is composed of three sections: an examination of materials related to medical illustration, a review of findings on creativity by psychologists, and a discussion of writings by educators and artists on teaching methodologies.

MEDICAL ILLUSTRATION LITERATURE

The review of the medical illustration literature is based on a search for relevant titles in the AMI Cummulative Bibliography 1967, the last ten years of Index Medicus and Art Index, and the card catalogues of the UTHSCD Medical Library. This search yielded over six-hundred fifty titles on the techniques, the history, and the role and purpose of medical illustration. A selected number of these books and articles have been examined. It appears that no author has dealt specifically with the topic under consideration, nor has any author established specific performance objectives for the professional medical illustrator. A list of "basic attributes for a student of medical illustration" was found. It reads:

1. Keen interest in science, in nature and all living things.
2. Ability to study intelligently, to observe accurately and to doubt statements of authority.
3. Ability to draw and paint from nature freehand and with artistic charm.
4. Ability to visualize, to imagine a picture based on previous study and then give it reality on paper, either with contour alone or with convincing plasticity.

5. Technical skill in drawing, a trustworthy eye guiding an obedient hand, preferably the right.
6. Ability to stick to a task with tenacity and to be resourceful in the face of obstacles.
7. Good general health and normal vision.[1]

This was written in 1941 by Max Broedel, the famous medical illustrator.

Since performance objectives would be helpful in clarifying the needed creative abilities, the following objectives have been drawn from the readings to be discussed in Chapter III. These objectives will constitute the operational definition of creativity as this study unfolds.

PROPOSED PERFORMANCE OBJECTIVES

At the conclusion of his or her studies, the professional medical illustrator will be able to:

1. Demonstrate ability to conceptualize and visualize medical pictures, designs or diagrams.
2. Demonstrate ability to abstract the essence of complex information and present it in visual form.
3. Manifest flexibility and versatility in the aesthetic handling of varied media and production techniques.
4. Exhibit adaptability to change in the medical environment and the new communications technology.

Many medical illustrators mention the need for creative abilities. In 1965, medical illustrator Frank Armitage, of the University of California at Los Angeles School of Medicine, inquired about aspects of artistic creativity in medical illustration, and made the following recommendation:

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[1]Max Broedel, "Medical Illustration," Journal of the American Medical Association Vol. 117, No. 1, August 30, 1941, p. 671.

> All I can do is try and stimulate you to raise the standard of medical art. . . . Your visual statement should contain imagination, should have control, should be creative and have a formative energy that is artistic.[2] These elements can make an 'illustration' a work of art.

However, the basic nature of creativity in medical illustration was not elucidated.

In a conversation on July 16, 1975, medical illustrator Steven Harrison, UTHSCD, stated that one of the hardest things to teach students is visualization and conceptualization. He said, "I think this is where a lot of the medical illustrator's creativity lies--to illustrate the subject from a different point of view in order to teach in the best possible way." Frank Netter, M.D., well known illustrator of the Ciba Collection of Medical Illustrations, says:

> To make diagrams and pictures of a subject one is studying is a natural instinct of the human intellect when it attempts to comprehend anything. Comprehension consists of the ability to visualize the subject.[3]

Dr. Netter says that comprehension of the aspects of a subject (anatomical, pathological, topographical, surgical) facilitates visualization.

Jean Wolfe, medical illustrator at the University of Pennsylvania, discusses the problem of visualizing a medical illustration by saying:

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[2]Frank Armitage, "Making Medical Illustration Art," Medical Art, Vol. 16, 1965, p. 7.

[3]Frank Netter, "Medical Illustrators Play Vital Role," AMA News, June 13, 1960.

> The first consideration is visualization of form on the page. This involves the selection of three components: key stages of the procedure to be illustrated; anatomical views such as external, sagittal or cut-away; field or range of focus from distance . . . down to microscopic.[4]

Decisions as to the procedures, views and range of focus can be made only after the operation is fully understood. Visualization, in the mind, then on the paper, can only come about through a clear comprehension of the subject, which requires study and thought. The creative thinking process will be considered further in Chapter IV.

CREATIVITY LITERATURE

In addition to the search through the literature of medical illustration, an effort was made in April of 1975, to find material through the ERIC system, using seventeen descriptors. Twenty-three titles were found; however, none were directly related to medical illustration education. Studies dealing with teaching and testing for creativity in elementary and secondary school pupils were prevalent in the ERIC printout. One publication of interest which was listed is Creativity--A Selected Review of Research. Research Into Higher Education Monographs.[5] This monograph describes the main research in creativity and has been useful as an introduction to other research sources.

Creativity has been a topic of interest to philosophers, poets, writers, scientists and artists since early Greek times. In our century,

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[4]Jean E. Wolfe, "Design in Relation to Surgical Illustration," Medical Art, Vol. 16, 1965, 8.

[5]James Freeman, Creativity--A Selected Review of Research. Research Into Higher Education Monographs, London, Society for Research into Higher Education, Ltd., Nov. 1968.

and particularly within the last two decades, interest has grown and creativity has become increasingly important in educational and psychological thinking.[6] The psychologist J. P. Guilford has summarized the history of the field before 1950:

> Creativity was almost entirely ignored by psychologists. Psychometric psychologists ruled creative potential out of intelligence, and behaviorism adopted a general viewpoint from which creativity could not be seen. Non-psychologists made a few attempts to fill the gap utilizing an anecdotal approach . . . almost nothing was learned about the nature of creative thinking itself.[7]

Since 1950, an extensive body of research on creativity by psychologists and others has been accumulated. In 1967, a new journal was founded, The Journal of Creative Behavior, for the publication of the growing volume of research.

For this study of creativity the following sources have been consulted: Psychological Abstracts, Dissertation Abstracts, Social Science and Humanities Index, and the card catalogue of the UTHSCD Library. These sources yielded hundreds of studies dealing with the creative process, product, personality, physiological basis[8], and educational methodologies.

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[6] J. W. Getzels, J. T. Dillon, "Giftedness and The Education of the Gifted," Second Handbook of Research on Teaching, Chicago, Rand McNally, 1973.

[7] J. P. Guilford, "Creativity: Yesterday, Today and Tomorrow," Journal of Creative Behavior, 1967, 1, pp. 3-14.

[8] J. E. Bogen, G. M. Bogen, "The Corpus Callosum and Creativity," Bulletin of the Los Angeles Neurological Societies, Vol. 34, #4, Oct. 1969, pp. 191-203, and Colin Martindale, et al, "The Differential Effect of Increased Arousal on Creative and Intellectual Performance," Journal of Genetic Psychology, 123: 329-335, Dec. 1973, and Colin Martindale, "What Makes Creative People Different," Psychology Today, July 1975, Vol. 9, #2, pp. 44-50.

Twenty-five articles were selected and examined. Noteworthy among the findings are the "Torrance Tests of Creativity,"[9] utilized as a tool in many of these studies. The tests author is Dr. E. Paul Torrance of the University of Georgia. Dr. Torrance, in response to a letter of request, sent two bibliographies of items with seven hundred fifty-one monographs of instructional materials which have utilized the "Torrance Tests of Creativity." Simply to read all these articles is a monumental task, so this writer focuses on one of Dr. Torrance's books, Guiding Creative Talent, and one of his articles, "Scientific Views of Creativity and Factors Affecting Its Growth." These studies have been found to be useful and will be reported on in Chapters IV and V.

EDUCATIONAL METHODOLOGY LITERATURE

A third body of literature considered in this review is the writing of educators, artists and art educators. Most of this literature is aimed at teachers of children and youth. However, some of the information is transferrable to higher education levels, as little has been written specifically on higher education and creativity. Paul Heist, teacher and research psychologist at the University of California, is concerned with creative college students. He found that these students tend to perform best in small discussion groups, and that creative students may be characterized by a high level of curiosity which is not satisfied in conventional classes.[10]

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[9]Torrance Tests of Creative Thinking, Personnel Press, Inc., Princeton, N. J., 1966.

[10]Paul Heist, The Creative College Student: An Unmet Challenge, San Francisco, Jossey-Bass, Inc., 1968, pp. 35-55.

The Southern Methodist University Library and Art Library have been sources for most of the forty-five education books and articles reviewed. There are relatively few publications, aside from technique books, about teaching art in higher education, and apparently there have been no works published concerning scientific illustration educational methodology.

There seems to be a convergence of reasons why educational methods for fostering creative thinking in higher education have been neglected in the past. Prior to 1950, psychologists had ignored creativity, and only recently have studies mushroomed, on one hand, and on the other, within the ranks of artists and art educators, there was disagreement about creativity. One group, exemplified by Victor D'Amico, says that creative thought is an elusive mystery and art should not be tampered with by the tools and methods of science. This group has made a mystique of creativity, perhaps because of their training which has not included science.

Another group of artists and art educators, including Viktor Lowenfeld, have been interested in investigating the phenomenon of creativity, and their ideas have recently become influential. While the psychologist J. P. Guilford was studying creativeness among scientists, art educator Viktor Lowenfeld and his associates were carrying on studies of artists. Reid Hastie, artist and educator, reports:

> It is significant that these two entirely independent studies with different experimental groups, testing the same phenomena, but for entirely different purposes, arrived at almost exactly the same criteria for distinguishing creative from noncreative or less creative persons. A study was conducted to correlate the two batteries of tests . . . . As far as the data of these two investigations are concerned, it is possible to

conclude that creativeness in the arts and sciences has common attributes.[11]

Hastie lists the criteria which characterized the creative artists and scientists:

1. Sensitivity to problems
2. Fluency of ideas
3. Originality
4. Ideational novelty
5. Flexibility of ideas
6. Synthesizing ability
7. Analyzing ability
8. Ability to reorganize or redefine
9. Span of ideational structure
10. Evaluative ability[12]

These personality characteristics are of interest for selection of medical illustration students. However, this thesis will not elaborate on the extensive material on personality characteristics of creative individuals as found in the literature.

Chapter III deals with the need for creative abilities in the field of medical illustration.

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[11] Reid Hastie, Encounter With Art, McGraw Hill, 1969, p. 190.

[12] Ibid.

CHAPTER III

THE MEDICAL ILLUSTRATOR'S NEED FOR CREATIVE ABILITY

On July 25, 1975, the occasion of the UTHSCD site visit by the Accreditation Committee of the AMI, George Lynch, of Bowman Grey Medical School, remarked that the work of the medical illustrator must be "educationally sound, scientifically well done, and beautiful to behold." Mr. Lynch is concerned with the changing role of the medical illustrator. On another occasion, that of his presidential address to the AMI, he said:

> Above all and regardless of what changes occur, as long as we call ourselves medical illustrators, we must maintain our purpose: to provide excellence in creative visualization and artistic skill as applied to medicine and the allied health sciences.[1]

The performance of the medical illustrator requires several aspects of creative ability. These artists must be able to visualize, conceptualize, and abstract scientific data in solving biomedical communications problems.[2] These persons should possess characteristics of versatility, adaptability and flexibility in order to produce instructional materials for many varied media. This chapter will describe these needed aspects of creativity as they apply to medical illustration.

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[1] George Lynch, "Medical Illustration, The Changing Scene," Medical and Biological Illustration, Vol. 21, 1971, pp. 95-97.

[2] Jerome Snyder, The Artist in the Service of Science, Zurich, Switzerland, The Graphis Press, 1973, Introductory page.

Despite the fact that no clear-cut, official performance objectives for the field of medical illustration were found in the literature, this writer discovered a wealth of information describing the work of the medical artist, and a list of qualifications for applicants (quoted on pages 7 and 8 of Chapter II). The medical illustration literature infers the need for a high level of creative ability. This writer has derived performance objectives based on the literature.

Many medical illustrators have written on the purpose and changing role of the medical artist. Their statements provide a clear picture of this evolving profession. Medical illustrator William Osburn writes:

> Historically, the medical illustrator has played a very important role in medical education, providing the creative, interpretive visual translations of biomedical information into forms more easily communicated in the learning process.[3]

VISUALIZATION

Visualization is basic to the illustrator. Biagio Melloni, Chairman of Medical and Dental Communications at Georgetown University, says:

> The actual work of making pictures begins with visualizing the problem at hand. Visualization is difficult only when the preliminary thinking-through is hasty or incomplete . . . . The final product should show no trace of the travail of creative effort. Focusing . . . the idea until it is mentally sharp and clear is second nature to the experienced medical illustrator.[4]

Visualization may be defined as the act or power of forming mentally a visual image of a subject not physically present to the eye. Visualization is then, the process of perceiving and assimilating information, then

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[3]William Osburn, "Educational Technology and the Medical Illustrator," Journal of the Association of Medical Illustrators, 1972, pp. 15-16.

[4]Biagio J. Melloni, "The Meaningful Approach," Journal of the AMI, 1961-62, pp. 5-8.

envisioning the material in a way that most lucidly conveys the idea. The "Father of modern medical illustration," Max Broedel, gives credit for the encouragement of visualization facility in himself to Dr. Howard A. Kelly, the noted surgeon. Dr. Kelly allowed his illustrators at Johns Hopkins School of Medicine the time to thoroughly investigate the anatcm-ical and pathological points involved in drawings.[5]

Within the parameters of scientific illustration there is latitude for the exercise of artistic creativity. This type of creativity is different from the originality of expression associated with the fine artist. For the medical illustrator, originality may consist of the ability to reduce the complexity of another person's ideas and restate these with clarity and directness.

Frequently the artist is requested to draw a surgical series of an operation which has already taken place, and to show procedures described orally by the surgeon. The illustrator works without firsthand observation, and must depend upon his or her own knowledge of anatomy, surgery and pathology to reconstruct the subject. Research and study are frequently necessary to supply specific details. The artist's ability to imagine and visualize the subject after an intellectual understanding is evidence of the creative problem-solving ability. The medical illustration student therefore, must master the creative ability to visualize medical subjects in the mind.

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[5]"Testimonial Dinner to H. A. Kelly," Bulletin of the Johns Hopkins Hospital, Vol. LIII, No. 2, Baltimore, The Johns Hopkins Press, 1933, p. 72.

CONCEPTUALIZATION

Dr. Frank Netter discusses the steps involved in creative conceptualization in medical illustration.

> With the essential point of the picture in mind, the artist may find three concepts helpful in planning it. These I call 'focus,' 'plane,' and 'point of view.' By 'focus" I mean the amount of the subject to be included in the picture. By 'plane' I mean the depth of the dissection. The artist must decide at what depth or plane of the body he will make his drawing. The term 'point of view' is self-explanatory, but it must be considered very carefully in planning an illustration. The artist must decide whether the essential points will best be demonstrated if the specimen is viewed from the front or back, right or left side, top or bottom, or from some particular angle. Here again good anatomical knowledge is required, for in order to make this decision intelligently, the artist must know what structures will be seen from these various viewpoints.[6]

After the basic decisions about focus, plane, and point of view have been made, the technical rendering is done and the work is brought to completion.

Conceptualization is an important aspect of creative ability in medical illustration. The term means the act or process of conceiving thoughts and ideas in the mind. For the medical illustrator, conceptualization is not only important in illustration, but also in designing instructional packages and graphics for television, films, exhibits and brochures. Conceptualization is also important in dealing with the masses of information to be presented through diagrams, charts and graphs. To be conceptual requires extensive basic knowledge as well as an inquiring and open mind. Modifications of realistic pictures, diagrams, schemes, charts and

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[6]Frank H. Netter, "A Medical Illustrator At Work," Ciba Symposium, Vol. 10 #6, May-June 1949, p. 1090.

graphs are helpful to students in medical and health sciences, who are learning new ideas. These aids help students in organizing, integrating and relating masses of information. Medical illustrator Nancy Joy says:

> To design these educational materials is one of the artist's most difficult problems . . . . Paradoxically, the less apparent the difficulties (the artist) has overcome, the greater his success.[7]

The student of medical illustration must learn to conceptualize--to conceive of ideas for presenting instructional materials in unique and suitable ways.

Many artists have spoken on the importance of creative conceptualization and visualization in medical illustration. Max Broedel, who had a profound influence on the field, believed that "the conceptualization of an illustration is the very basis of all creative drawings."[8] He placed great value on research, initiative and originality in his work. Mr. Broedel explains:

> All medical illustrating is either imitative or creative. To imitate is relatively simple, but to create much more difficult. Any artist can imitate, but so can the camera with the difference that it often does it better and always quicker and cheaper. . . . but photography has its limitations and it was not hard to see where and why it fell short. I knew that it would be useless for me to compete with the camera in the realistic or imitative field. It was necessary to originate a different type of picture, one that would show far more than any photograph could ever

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[7]Nancy Joy, Medical Illustration, Guidance Center Occupational Information Monographs, University of Toronto, Toronto, Canada, 1970.

[8]Max Broedel, "Testimonial Dinner to H. A. Kelly," Bulletin of the Johns Hopkins Hospital, Vol. IIII, No. 2, Baltimore, The Johns Hopkins Press, 1933, p. 71.

> do. To make such a picture is much more difficult. The artist must first fully comprehend the subject matter from every standpoint: anatomical, topographical, histological, pathological, medical and surgical. From this accumulated knowledge grows a mental picture, from which again crystallizes the plan of the future drawing. A clear and vivid mental picture always must precede the actual picture on paper. The planning of the picture, therefore, is the all important thing, not the execution.[9]

Medical illustrators are sometimes asked, "Hasn't the camera eliminated the need for medical art work?" The answer is, of course, "no," but fortunately, the camera has made it unnecessary for the artist to handle many tedious assignments such as recording exact appearances of anatomical specimens or pathological lesions.

ABSTRACTION

The need for creativity is discussed by medical illustrator Robert Demarest, of Columbia University, who says, "The creative personality is the new elite,"[10] and that the real role of the illustrator today is to "interpret or add an intelligence to what he sees in front of him, to eliminate unnecessary detail, and to abstract what's going on for teaching purposes."[11] Some of Webster's definitions of the term "abstraction" are relevant: "distillation or being abstracted, removal; formation of an idea, as of qualities and properties of a thing, by mental separation from particular instances." Abstraction, in the sense of refining away the

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[9] Ibid.

[10] Robert J. Demarest, "AMI Presidential Address," Journal of the AMI, 1970, pp. 21-22.

[11] "Medical Illustration: The Current State of the Art," Medical World News, Nov. 26, 1971, p. 37.

peripheral elements, and distilling material to the essential points, clarifies medical subject matter and conveys the significant meaning to the target audience. The medical illustration student must master the ability to abstract, to recognize the essentials of complex data, in order to produce clear medical teaching materials.

Conceptualization, visualization and abstraction are the selective creative abilities that the camera cannot provide. Netter, discussing the limitation of the camera, says it is too "faithful" because it gives everything in view equal importance. The artist's selectivity in representing the most essential aspects of a surgical procedure is important because the client only wants to see that in which he is interested. Further, Netter says,

> Planning is the hardest part of the job. Creativity lies in the concept rather than in putting it down. You know a piece of paper is just so big. It doesn't take long to cover it with paint.[12]

In addition to creative abilities to conceptualize, visualize and abstract information, flexibility, versatility and adaptability are essential characteristics of today's medical illustrator.

ADAPTABILITY

Alvin Toffler, a most articulate contemporary social analyst, speaks of the implications of technological revolution:

> The acceleration of change radically alters the balance between novel and familiar situations. Rising rates of change compel us not merely to cope with a faster flow,

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[12]Arthur J. Snider, "He Traded His Scalpel for a Pen," Science Editorial, Chicago Daily News, April 14, 1973.

> but with more and more situations to which previous personal experience does not apply . . . . To survive, to avert what we have termed future shock, the individual must become infinitely more adaptable and capable than ever before.[13]

Medical illustration reflects the changing medical environment, and has itself undergone change. Imagination and innovation are more in demand, more needed than ever before, since the new communications technology has increased the uses for medical illustration. The student must acquire adaptability and alertness to alternatives for solving medical communications problems. Professor A. Hooker Goodwin of the University of Illinois, says:

> Medical illustration is going through another renaissance. It is going beyond the drawing board. The artist is not just doing straight illustrations for journals and textbooks any more. The electronic media have forced medical artists to enlarge their scope.[14]

Adaptability is an essential for coping with the changing demands of medical education.

FLEXIBILITY AND VERSATILITY

Flexibility and versatility are characteristics which allow the use of a broad range of media and techniques in problem solving. Mark Weakley, in his medical illustration master's thesis, finds that the average art staff is one to two persons in a total department of one to five. The significance of these figures is that the practicing medical illustrator plays several roles.[15] Therefore, the student of medical illustration should

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[13]Alvin Toffler, Future Shock, New York, Bantam Books, 1970, p. 34.

[14]Arthur J. Snider, "He Traded His Scalpel For A Pen," Chicago Daily News, April 14, 1973.

[15]Mark Weakley, A Survey Analyzin Current Employment Patterns of Medical Illustrators, M.A. Thesis, UTHSCD, 1975, p. 46.

become a flexible, versatile person, capable of handling varied areas of production. The wide variety of assignments handled by the modern medical illustrator calls for a broad understanding of medicine, a broad knowledge of art techniques and problem-solving abilities.

Thus we have seen there is a need for conceptualization, visualization and abstraction abilities, and characteristics of adaptability, flexibility and versatility in medical illustration. The performance objectives introduced in Chapter II summarize these needs. Those performance objectives were:

> At the conclusion of his or her studies the professional medical illustrator will be able to:
>
> 1. Demonstrate ability to conceptualize and visualize medical pictures, designs or diagrams.
> 2. Demonstrate ability to abstract the essence of complex information and present it in visual form.
> 3. Manifest flexibility and versatility in the aesthetic handling of varied media and production techniques.
> 4. Exhibit adaptability to change in the medical environment and the new communications technology.

The mastery of these objectives allows the student to build a career based on a confident and sound footing.

The medical illustrator not only makes drawings for anatomy and surgery textbooks and journals, but also designs graphics and cartoons for television, slide-tape and film productions, makes prosthetics, plans three dimensional exhibits, produces charts, graphs, teaching aids, posters

and brochure designs, directs photography services and teaches others directly and indirectly, thus becoming the "new Leonardo da Vinci." The art of medical illustration lies in creating materials that communicate effectively and contain originality as distinguished from mere skill, without compromising the educational goals.

CHAPTER IV

RESEARCH FINDINGS ON CREATIVITY

What is creativity? This term has been defined from a number of perspectives, (a) from the viewpoint that creativity is a flexible, fruitful process, (b) creativity as viewed in terms of a novel and useful product, and (c) creativity from the point of view of subjective human experience.[1] Each of these vantage points will be examined in the first section of this chapter. The second part of the chapter will deal with the steps in the creative process.

DEFINING "CREATIVITY"

The word "creativity" seems to imply the God-like ability to make something out of nothing. However, such achievement is difficult to accept because as far as we know, new forms develop only through the recombination of things that already exist. Therefore, "creativity" does not mean the making of something out of nothing in the Biblical sense, but rather means nearly the same thing as "invention." According to Sir Herbert Read, the philosopher of art, invention implies "previously existing objects or facts, with the mind merely an agent that arranges or combines them in a new order."[2] Without the new organization, which we call an idea, or

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[1]Paul Torrance, "Scientific Views of Creativity and Factors Affecting Its Growth," Creativity and Learning, Boston, Beacon Press, 1967, p. 73.

[2]Herbert Read, Education Through Art, Pantheon Books, Inc., N. Y., 1958, p. 113.

conceptualization, in the mind, few elements are likely to be juxtaposed except by accident or evolution.[3] Conceptualization, as we have seen in Chapter III, is a needed ability in medical art. The initial conceptual rearrangement is conceived in the mind, and the external existence of the new configuration indicates that creativity has taken place. Creativity seems to be the ability to combine successfully things that are usually treated separately. With this understanding as a basis, definitions of creativity as process, as product and as experience will be discussed.

DEFINITIONS IN TERMS OF "PROCESS"

Brewster Ghiselin, Alvin Toffler and Paul Torrance all define creativity as a dynamic process. Brewster Ghiselin, poet, writes in The Creative Process, "The creative process is the process of change, of development, of evolution, in the organization of subjective life," and he adds," . . . insight into the processes of invention can increase the efficiency of almost any developed and active intelligence. Not even the most vigorously creative minds always find their way quickly to efficiency."[4] It is the creative process which culminates in new concepts and products which are suited to needs brought about through changes in society. Creative persons are able to adapt to new or changed circumstances. Ghiselin suggests that intelligent people benefit from understanding the creative process. Since one of the highest characteristics of giftedness is the

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[3]Buckminster Fuller, I Seem To Be A Verb, N.Y. Bantam Books, 1970, p. 6. Mr. Fuller says, "I am convinced that creativity is a priori to the integrity of the universe . . .; i.e., evolution is itself a form of creativity.

[4]Brewster Ghiselin, The Creative Process, N.Y., Mentor Books, 1952, p. 12.

ability to conceptualize and invent, we cannot afford to neglect the development of this capability. Increasing our knowledge of the process by which inventions and discoveries are made will help improve efficiency.

Alvin Toffler, in his fascinating study of trends in contemporary life, Future Shock, writes:

> The essence of creativity is a willingness to play the fool, to toy with the absurd, only later submitting the stream of ideas to harsh critical judgment . . . we need sanctuaries for . . . imagination.[5]

Toffler believes that creativity thrives in an environment in which novel conceptualizations can be freely expressed before being critically evaluated. Experimentation, "playing the fool," and suspension of judgment are important for idea-hatching.

E. Paul Torrance, an outstanding investigator of creativity, feels that the following definition fits the creativity of artists, writers and scientists:

> I have defined creativity as the process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, etc.; identifying the difficulties; searching for solutions, making guesses and formulating hypotheses about the deficiencies; testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results. This definition describes a natural human process.[6]

Studies conducted by Torrance suggest that outstanding creativity is seldom found among students of below average IQ, but that IQ's above 115 or 120 have no apparent bearing on creativity. He concludes that normally

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[5] Alvin Toffler, Future Shock, N. Y. Bantam Books, 1970, p. 464.

[6] E. Paul Torrance, "Scientific Views of Creativity and Factors Affecting Its Growth," Daedalus, Vol. 94, #3, 1965, p. 663.

intelligent individuals' potential achievement is not limited by their IQ scores.[7] If we accept creativity as a complex of human abilities possessed to different degrees by all people, then we can consider instructional methods which seem more productive of improving creativity. Torrance discusses the factors which influence creative thought and activity in: Guiding Creative Talent, Creative Learning and Teaching, Encouraging Creativity in The Classroom, and Education and the Creative Potential. Specific points on methodologies will be elaborated in Chapter V.

DEFINITIONS IN TERMS OF "PRODUCT"

Donald MacKinnon, Philip Jackson, Samuel Messick and John Arnold present definitions of creativity in terms of a product. Donald MacKinnon, Emeritus Professor of Psychology and Research Psychologist at Berkeley, presents a three-part definition.

> . . . (creativeness) involves a response or an idea that is novel or at the very least statistically infrequent. But novelty or originality of thought or action, while a necessary aspect of creativity is not sufficient. The response . . . must serve to solve a problem, fit a situation, or accomplish some recognizable goal. And thirdly, true creativeness involves a sustaining of the original insight, an evaluation and elaboration of it, a developing of it to the full.[8]

From this viewpoint, the creative product may be a painting, a mathematical theory, a novel, a mechanical invention, a poem, a pun, an architectural design, a medical illustration, a theory of creativity or any of a number

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[7] E. Paul Torrance; Guiding Creative Talent, N.J., Englewood Cliffs, Prentice Hall, 1962, p. 63.

[8] Donald W. MacKinnon, "The Nature and Nurture of Creative Talent," American Psychologist, Vol. 17, No. 7, July 1962, p. 485.

of other possible products as long as the criteria of originality, goal adaptation and realization are met. In MacKinnon's terms, the dilettante who does not carry a work to completion and the psychotic who is out of touch with reality are not creative.

Philip W. Jackson, Professor of Education and Human Development at the University of Chicago, and Samuel J. Messick, Psychologist at the Educational Testing Service in Princeton, New Jersey, state that "creativity" refers to a product. These authors write:

> No matter what other positive qualities it might possess, we generally insist that as a first step a product be novel before we are willing to call it creative . . . . Although the judgment of uniqueness or infrequency is a logical first step in evaluating the creativeness of a product . . . somehow the mere oddities must be weeded out. This task requires the application of a second criterion, appropriateness.[9]

To the terms "novelty" and "appropriateness," Jackson and Messick add the terms "transformation" and "condensation" to the descriptors of the creative product. They say that a reservoir of knowledge is essential for the transformation of old ideas into new creative ideas. The element "condensation" refers to the concentration of meaning, intensity, economy and removal of the non-essential. "Condensation" means distilling of the essence, or abstraction. We have seen in Chapter II that abstraction ability is needed in medical illustration. Novelty, appropriateness, transformation and condensation characterize the creative product, according to Jackson and Messick.

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[9]Philip W. Jackson and Samuel Messick, "The Person, The Product and the Response," Creativity and Learning, Boston, Beacon Press, 1967, pp. 3-4.

The noted chemical engineer John Arnold, of Massachusetts Institute of Technology, conceives of creativity as an intellectual process in which past experiences are adapted to produce a new pattern. He writes of parameters on the new configuration, which delimit what products can truly be called creative. These restrictions are:

> The new combination must be a better combination, not just different than has previously existed . . . . The solution must be a tangible solution . . . the combination must be forwardly oriented in time, truly new . . . . The combination has a synergetic quality; it is greater than the sum of its parts.[10]

DEFINITIONS IN TERMS OF "EXPERIENCE"

Rudolf Arnheim, Carl Rogers, Jerome Weisner and Marshall McLuhan formulate definitions of creativity from the standpoint of experience.

Rudolf Arnheim, Professor of Psychology of Art at Harvard, asserts that all thinking, not just thinking related to art, is basically perceptual, and that the dichotomy between seeing and thinking is misleading. Arnheim speaks of the value of direct experience in creative thought:

> . . . some psychologists talk about creativity or originality by using the term "divergent thinking." That irritates me. Originality is not being different, it means getting back to the origin, to the roots of one's experience. You have to go back to the object, the way it smells, the way it feels, the way it is . . . . You will find that the great discoveries in each of the sciences came from people who ignored existing concepts to get back to the experience.[11]

The acquisition of direct sensations and first-hand knowledge of objects is

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[10]John E. Arnold, "Creativity in Engineering," Creativity, An Examination of the Creative Proce N. Y., Hastings House, 1959.

[11]James R. Peterson, "Eyes Have They But They See Not; A Conversation With Rudolf Arnheim," Psychology Today, June 1972, Vol. 6, #1, pp. 56-58.

the basis for creative intelligence. Stored knowledge and ideas from one's experience can be recalled and combined in new arrangements and creative juxtapositions. Arnheim's concern for the thoughtful observation of nature and the man-made environment is the basis for his theory of "Visual Thinking,"[12] and we have seen in Chapter III that visualization is a creative ability necessary in medical illustration.

The well-known clinical psychologist, Carl Rogers, says:

> My definition . . . of the creative process is that it is the emergence in action of a novel relational product, growing out of the uniqueness of the individual on the one hand, and the materials, events, or circumstances of his life on the other.[13]

Flexibility and openness to experience are basic for accumulation of information, according to Rogers. The information is then adapted into new combinations to create novel solutions to problems. Rogers' major work has been the development of "client-centered therapy." He teaches the client to pay direct attention to his or her own experiences, responses, spontaneous feelings and internal evaluations, rather than imposing a system of thought from the therapist's framework. Rogers' ideas have influenced educators because his theory and methods constitute a form of education, or rather re-education. He has written recently on student-centered teaching.[14]

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[12]Rudolf Arnheim, Visual Thinking, Berkeley, University of California Press, 1969.

[13]Carl R. Rogers, "Towards a Theory of Creativity," Creativity, Baltimore, Md., Penguin Books, Ltd., 1970, p. 139.

[14]Carl R. Rogers, Freedom to Learn, Columbus, Ohio, Merril Publishing Co., 1969.

Jerome Weisner, Dean of the School of Science at Massachusetts Institute of Technology, speaks of creativity as it relates to the intellectual realm of experience. He discusses the characteristics of creative contributions to science in particular.

> The term "creativity" is principally used to mean activity resulting in contributions that have novelty and value in the . . . sciences, as well as literature, music and the visual arts. In all such contexts, "creativity" universally implies a departure from and advance beyond what is conventionally attainable. However, there is an important characteristic of creative contributions in science that is not significantly present in creative contributions in many other fields . . . a new idea or concept must meet the criterion of being logically relatable in quantitative terms, to the body of science in order to be considered productive.[15]

This criterion not only applies in science, but also in scientific illustration. A creative medical illustration must contain clear relationships to existing medical knowledge. No matter how elegant or appealing the illustration, if it is not accurately related to the facts of medical science, this illustration is useless.

Marshall McLuhan, the renowned media expert, suggests creative adaptation as an attitude toward experience:

> Survival is not possible if one approaches his environment, the social drama, with a fixed unchangeable point of view, the witness repetitive response to the unperceived . . . . Our time is a time for crossing barriers, for erasing old categories, for probing around. When two seemingly disparate elements are imaginatively poised, put in apposition in new and unique ways, startling discoveries often result.[16]

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[15] Jerome B. Weisner, "Education for Creativity in the Sciences," Daedalus, Vol. 94, #3, 1965, p. 528.

[16] Marshall McLuhan, The Medium is the Massage, N. Y. Bantam Books, Inc., 1967, p. 10.

Both Marshall McLuhan and Alvin Toffler view creativity as characterized by flexibility, versatility and adaptability. Of course these characteristics are necessary to the medical illustrator as was discussed in Chapter III. The emphasis is on perception of, and adaptation to, the tremendous changes brought about by technology and the knowledge explosion in the twentieth century.

These definitions have been presented to show that there is no single universally agreed-upon definition of creativity. Recently the concept of creativity has been considered to be at least as important as the concept of intelligence. University of Chicago psychologists J. W. Getzels and J. T. Dillon, offer an inclusive definition:

> In creative thinking, the product has novelty and value for the thinker or the culture; the thinking is unconventional, highly motivated, and persistent or of great intensity; the task involves a clear formulation of an initially vague and undefined problem.[17]

In writing this paper, the writer finds the "creative muddle" to be a starting point. Clarity evolves out of the research process, which is analogous to the creative process, discussed in the following section.

STAGES IN THE CREATIVE PROCESS

How does the creative process work? While the definition of creativity is somewhat unresolved, there seems to be general consensus about the stages in the creative process. Many authors such as Wallas, Torrance and Guilford[18] describe this process as having the following steps:

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[17] J. W. Getzels and J. T. Dillon, "Giftedness and the Education of the Gifted," Second Handbook of Research on Teaching, Chicago, Rand McNally, 1973, pp. 698-699.

[18] Graham Wallas, The Art of Thought, London, C. A. Watts, 1926, p. 80, and Paul E. Torrance, Guiding Creative Talent, Englewood Cliff, N.J.,

A. Identification of a need

B. Preparation and concentrated study of the problem

C. Incubation, a period of conscious and subconscious gestation or synthesis of material

D. Illumination, insight and visualization of a solution

E. Elaboration and verification of the concept

The creative process is a thinking process. John Dewey, the great educational philosopher, wrote in 1916:

> The starting point of any process of thinking is something going on, something which just as it stands is incomplete or unfulfilled. Its point, its meaning lies literally in what it is going to be, in how it is going to turn out . . . . All thinking is original with him who carries it on . . . . It also follows that all thinking involves a risk. Certainty cannot be guaranteed in advance. The invasion of the unknown is of the nature of an adventure . . . . Ultimately the value of knowledge is subordinate to its use in thinking . . . . For we live not in a settled and finished world, but one which is going on, and where our main task is prospective.[19]

Dewey's steps in the thinking process appear to be analogous to the steps in creating. His stages in thinking are:

A. The sense of a problem
B. The observation of conditions
C. The formation of a conclusion
D. The rational elaboration of a suggested conclusion
E. The active experimental testing of the conclusion[20]

Prentice Hall, 1962, p. 17, and J. P. Guilford, Intelligence, Creativity, and Their Educational Implications, San Diego, Knapp Publishers, 1968, pp. 121-127.

[19]John Dewey, "Experience and Thinking," Democracy and Education, N. Y., The Macmillan Co., 1916, pp. 171-178.

[20]Ibid.

The creative process begins in a state of imaginative, muddled suspense, with a feeling of a need or deficiency which requires resolution. After sensing and "pinning down" the problem, a period of concentrated effort and careful preparation begins with exploration, studying, sketching, discussing and formulating many possible solutions. It is out of this store of accumulated information, ideas and images that the new creative conceptualization or visualization comes. Louis Pasteur, the great nineteenth century scientist, recognized the importance of the preparatory state in this process when he said, "Chance only favours the prepared mind."[21] If no clear-cut solution appears immediately, the resulting tension causes the individual to move away from the problem and "incubate." A conscious and subconscious digestion and assimilation of the acquired information takes place. Brewster Ghiselin suggests: "Among the conditions to which every inventor must submit is the necessity for patience. The development desired may have to be waited for, even though its character has been intimated."[22] Eventually out of the period of withdrawal from the problem, by a flash of "inspiration" or insight, the pieces of the puzzle fit together in a creative synthesis and the idea is born. The artist, writer or scientist then elaborates, tests and perfects the idea. The painting, sculpture, story, poem, or scientific theory is made. In Gestalt terms, the process has reached a state of closure.

Numerous artists and scientists give accounts of the creative process. The French mathematician, Henri Poincarē, writes of the insight

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[21] Louis Pasteur, quoted by Maurice B. Strauss (Ed.), Familiar Medical Quotations, Boston, Little, Brown and Co., 1968, p. 108a.

[22] Brewster Ghiselin, The Creative Process, N.Y. Mentor Books, 1952, p. 27.

stage, after a preparatory period of absorption in a problem:

> For fifteen days I strove to prove that there could not be any functions like those I have since established. Every day I seated myself at my work table . . . tried a great number of combinations, and reached no results. One evening contrary to my custom, I drank black coffee and could not sleep. Ideas arose in crowds: I felt them collide until pairs interlocked, making a stable combination. By the next morning I had established the existence of a class of . . . functions . . . I had only to write out the results, which took but a few hours.[23]

Pablo Picasso, the painter and inventor of cubism, discusses the stages in the creation of a painting:

> The painter passes through states of fullness and emptying. That is the whole secret of art. I take a walk in the forest of Fontainebleau. There I get an indigestion of greenness. I must empty this sensation into a picture. Green dominates in it. The painter paints as if in urgent need to discharge himself of his sensations and his visions.[24]

The preparation and incubation periods represent the state of "fullness." The insight or point of illumination occurs with the "indigestion" Picasso mentions, and then he must elaborate his visualizations in the "emptying" state by painting the picture.

Albert Einstein was asked in a letter from a colleague about Einstein's thinking process in mathematics. He answered:

> . . . taken from a psychological viewpoint . . . combinatory play seems to be the essential feature in productive thought--before there is any connection in words or other kinds of signs which can be communicated.[25]

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[23] Henri Poincaré, "Mathematical Creation," The Creative Process, N. Y. Mentor Books, 1952, p. 36.

[24] Christian Zervos, "Conversation with Picasso," The Creative Process, N. Y. Mentor Books, 1952, p. 59.

[25] Albert Einstein, "The Letter of Albert Einstein to M. Hadamard," The Creative Process, N. Y. Mentor Books, 1952, p. 43.

He mentions as essential the vague "combinatory play" and "associative play" with mathematical elements. This combinatory play occurs during the incubation stage, before the flash of insight. Combining elements in different ways indicates mental flexibility.

Ghiselin, speaking about the management of the creative process, reminds us:

> . . . it is essential to remember that the creative end is never in full sight at the beginning and that it is brought wholly into view only when the process of creation is completed.[26]

CREATIVE OCCUPATIONS

The stress in our society has been upon conforming modes of action and thought, and independent thinking and acting differ from the orthodox manner of thought and action.

There are certain occupations in which original and independent thinking are necessary. These occupations based directly on creativity are science and art. These fields require flexible persons with the ability to discover new or rare concepts, visualizations and solutions to problems. The sociologist, Elliot Krause of Northeastern University in Boston, says:

> The creative functions of the basic scientist and the dedicated artist are very similar, if not identical, in terms of their role in changing the ideas . . . in a given society.[27]

This is not to imply that creative work is not done in other fields;

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[26]Brewster Ghiselin, The Creative Process, N. Y. Mentor Books, 1952, p. 21.

[27]Elliot A. Krause, The Sociology of Occupations, Boston, Little, Brown and Co., 1971, p. 256.

however, the point is this: creating is the main task for artists and scientists.[28]

SCIENTIFIC METHOD AND CREATIVE PROCESS

The scientific method is the basis for the formulation of scientific theories. An interesting and important parallel exists between the phases of the creative process and the phases of the scientific method.[29] The steps in the scientific method are outlined by biologists James Otto and Albert Towle:

1. Defining the problem
2. Collecting information relating to the problem
3. Formulating a hypothesis
4. Experimenting to test the hypothesis
5. Observing the experiment
6. Organizing and recording data from an experiment
7. Drawing conclusions
8. Accurate reporting of research methods, results and conclusion.[30]

The similarities are obvious between the creative process and scientific method. It is said that Leonardo da Vinci was an exponent of the experimental method in both art and science. The scientific, "experimental," or "research" method is essentially the same as the "creative process." Both

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[28] Ibid., p. 271. We may ask, "Who makes the greatest contribution in terms of creative ideas and products?" This writer is concerned with clarification of creativity, not evaluation. The decision as to who is more creative and more valuable involves the social milieu of the creator and the created product.

[29] Geoffrey LaPage, "Creative Process In Science and Art," Art and The Scientist, Bristol, John Wright and Sons, Ltd., 1961, pp. 83-106, and Hans Krebs and Julian Shelley, Creative Process in Science and Medicine, American Elsevier Publishing Co., N.Y., 1975.

[30] James H. Otto and Albert Towle, Modern Biology, N.Y., Holt, Rinehart and Winston, Inc., 1965, pp. 8-11.

are different from the "technical method," as follows:

1. Follow an outlined procedure without variation
2. Make observations
3. Record findings[31]

TECHNIQUE

The American Heritage Dictionary defines "technique" as: "The systematic procedure by which a task is accomplished, and the degree of skill shown in any performance." A "technician" is defined as "an expert in a technique." This writer will differentiate between technique and the creative process. These are different entities, though it is true that the verification and elaboration stage in the creative process is carried out via a technique.

Laboratory technicians use established procedures to verify and check results. There are many more technicians than basic research scientists. Scientists, of course, are technically skilled, but in order to successfully conduct research they must go beyond rigid procedures. This transcendence is associated with alertness to alternatives, flexibility and curiosity. Harvard psychologist Norman Mackworth says:

> Good scientists have to be careful conservatives and wild radicals almost at the same time . . . . Conformity is the cardinal sin. Good scientists must not only be willing to take risks but they must in fact positively enjoy doing so indeed they have been termed intelligent, bold introverts.[32]

The American Heritage Dictionary defines "invention" as the act or process of inventing or a new device developed from study and experimenting.

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[31] Ibid.

[32] Norman Mackworth, "Originality," American Psychologist, Vol. 20, 1965, p. 55.

"Invention" implies mental flexibility and versatility. There is a popular assumption that technical proficiency is parallel to creativity, and people often equate the two. As we examine the definitions of "technique" and "invention," we see that they are different. Sociologists Joseph Bensman and Robert Lilienfeld, of City University of New York, remark:

> The academic person, quite frequently, in attempting to explain the process of creativity describes the techniques of artistic production as if knowledge of the techniques in and of themselves, constituted a solution to the problem of creativity. It is perhaps necessary for the academician to do so since technique is the most objective and discernible part of the process of artistic creation. Somewhere beneath these procedures lie the hidden sources of creativity, ideas, images, feelings which guide and direct technique.[33]

Conceptualization precedes the technical elaboration and verification stage in the creative process. Technique is difficult and requires hard work, but in order to accomplish the full realization of a creative idea, the individual desires technical mastery and perfection. Without the need to express an idea, technique alone is unsatisfying to the creative individual. Viktor Lowenfeld, the "Father of contemporary art education," writes:

> Usually technical performance goes hand in hand with the meaningfulness of the (individual's) work. This should not surprise us, for it is the urge to express something meaningful which creates the desire for greater perfection. Technique grows out of the urge for expression.[34]

CONCLUSIONS

A clear understanding of the stages in the creative process aids

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[33] Joseph Bensman and Robert Lilienfeld, Craft and Consciousness, N.Y., John Wiley and Sons, 1973, p. 21.

[34] Viktor Lowenfeld, Creative and Mental Growth, N.Y., The Macmillan Co., 1957, p. 47.

the teacher in planning projects in the medical illustration program. An adequate time allowance for each step is important. Preparation, collection of information, then gestation of the concept may require a considerable amount of time for experimental trial and error. The student's conscious and subconscious mind may be actively working on a conceptualization and way of visualizing without much external, tangible evidence. Rough sketches and notes are made in the preparation stage, and the information is assimilated and sorted for its essentials in the incubation stage, which may be long or short. If the student has difficulty reaching the insight stage where a concept is formulated and visualized, the teacher can encourage flexible thinking at this point by discussing the problem and its alternative solutions with the student. The insight or illumination stage itself is short, and then the concept is no longer muddled. The elaboration and rendering of the drawing proceeds when the idea is clearly illuminated and visualized in the mind. Idea must precede representation.

The preparation and incubation stages are usually the most time consuming and difficult in the process of visualizing a new medical illustration. Anatomical, histological, pathological and surgical facts must be understood thoroughly before the flash of insight or concept for presentation takes form. The insight phase occurs momentarily, and the last step of elaboration and rendering of the idea requires hard work, revision and refinement. Versatility and mastery of technique are essential means to an end.

Time for each of the stages is essential. Confusion and anxiety may result when inadequate time is allowed for the preparation and incubation

stages. If too many assignments are given at one time, with inadequate time allowed for each, the first concept which comes to mind may be accepted, rather than the best of several alternatives, which are produced in the complete assimilation of elements and the weighing of many possibilities. Time pressure may not allow for an adequate incubation period, which is important for clear visualization and conceptualization.

We have seen that creativity is the intellectual ability to form concepts, abstract ideas and mental visualizations, and we have seen that creativity is characterized by mental flexibility, versatility and adaptability. Mastery of these creative skills is the objective of teaching medical illustration. Most students can master them and it is the task of instruction to find the means which will enable students to master these abilities. The following chapter discusses the implications of research on creativity for teaching.

CHAPTER V

EDUCATIONAL METHODOLOGIES FOR FOSTERING CREATIVITY

The teacher's role in the training of creative, skilled and knowledgeable medical illustrators is crucial. The teacher not only sets a personal example, but also establishes the learning climate by arranging the conditions which expedite learning. Educational psychologists John Wilson, Mildred Robeck and William Michael state: "The enthusiasm and dedication of the teacher are key ingredients in the reinforcement that eventually builds into motivation."[1]

The teacher has a very strong and firm function in creating the educational environment. The task of the teacher is providing resources and favorable circumstances which promote learning of principles, technical skills and problem solving. The teacher who is motivated, student-centered, and encouraging, has been found to affect the student's creativity significantly. Sir Hans Krebs, Nobel Prize winning biochemist, credits his teacher with fostering his work:

> I owe a great deal to my main teacher, Otto Warburg. The question has been asked as to what extent creativity can be taught. I am sure that the fact that I worked for over four years in the same room with a scientist of outstanding creative ability has benefited me enormously. Warburg set

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[1] John Wilson, Mildred Robeck, and William Michael, Psychological Foundations of Learning and Teaching, McGraw Hill Book Co., 1969, p. 124.

> an example in the methods and quality of first-rate research. He impressed me by asking the right kind of questions, by forging new tools for tackling the chosen problems, by being ruthless in self-criticism, by taking pains in verifying facts and expressing results and ideas clearly and concisely.[2]

Other "breakthrough" scientists, when asked by the National Science Foundation what they felt was the most favorable factor in their education, answered, "Intimate association with a great, inspiring teacher."[3]

Learning takes place in proportion to stimulation. Painter Allen Leepa, who teaches at Michigan State University, says,

> Teaching is not laissez faire. When he introduces a new idea it is his responsibility to present it with all the clarity he can and relate it as intimately and poignantly as possible to the ideas of the student. When he responds to a student's work he must bring in those ideas that seem to be most relevant to the student's understanding, direction and experience. But his goal is guidance rather than stimulus-response, conditioned-reflex behavior. His emphasis is constantly on evolking the student into dialogues with himself. By guiding the student's thinking, he helps him see the possibility of new ideas and new behavioral responses . . . . If the student does not respond to the particular idea that he presents, he must be imaginative enough to explore others with the student until he finds clues and keys to the student's understanding.[4]

Many methodologists agree that the teacher's understanding of, and attitude toward creativity are important factors in fostering creativity.[5]

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[2]Hans A. Krebs and Julian Shelley, "Creativity in the Biological Sciences," The Creative Process in Science and Medicine, N.Y., American Elsevier Publishing Co., 1975, pp. 92-93.

[3]Buckminster Fuller, I Seem To Be A Verb, Bantam Books, 1970, p. 82B.

[4]Allen Leepa, "Art and Self," New Ideas in Art Education, Dutton, 1973, p. 178.

[5]Carl R. Rogers, "The Interpersonal Relationahip in the Facilitation of Learning," Freedom To Learn, Merril Co., 1969, pp. 106-112.

The promotion of creative abilities and characteristics is dependent upon the teacher who develops methods and a climate amenable to creative activity.

A teaching "method" is comprised of the systematic procedures used to present instructional material. More broadly, "method" refers to the manner in which the teacher treats students. All teachers have methods, whether acknowledged or not. Adult educator, Malcolm Knowles, writes:

> The fact is that there are assumptions, concepts and principles behind everything you do, whether you are conscious of them or not. If you are planning an educational activity in (any subject), you are going to have to make decisions about content, techniques to be used, units of instruction and sequence time and place, and standards for evaluation. For each decision you will be confronted with a number of options, and your choice will be determined by some idea of what will work best.[6]

The person who wishes to teach for creative conceptualization, visualization and abstraction needs to understand the steps in the creative process in order to make practical decisions about time, sequence, and motivational devices. One who teaches for creative abilities is attempting an important task. Satisfaction comes when the teacher has increased the student's capabilities for problem solving. Psychologist Anne Roe says, "Genuinely creative behavior emerges at the highest level of behavior, Maslow's level of self-actualization."[7]

Instructional goals for the teacher of medical illustration should

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[6]Malcolm Knowles, The Adult Learner: A Neglected Species, Houston, Gulf, 1973, p. 92.

[7]Anne Roe, The Psychology of Occupations, N.Y., John Wiley & Sons, 1956, p. 35.

include a parallel development of knowledge, technical skills and creative problem-solving ability. Ann McGee, art professor at Southern Methodist University, in a discussion on July 2, 1975, commented, "If you don't get the idea of creativity in early in training, you don't get it in." Similarly, Marshall McLuhan writes, "As we begin, so shall we go."[8] The teacher who takes a problem-solving approach all the way along promotes creative work.

Medical illustration has a strong traditional orientation in terms of media and technique, and today encompasses a large body of medical and communications knowledge. Therefore, the prospective medical illustrator needs guidance, as students cannot be expected to acquire this vast body of material alone. Because of expanded communications media and technology, as well as advances in medical science and practice, the teacher of medical illustration must develop a methodology which stresses adaptability to changing conditions. The education and training period should be applicable to the illustrator's working lifetime. Contemporary educators consider future changes. Many educators are now concerned with teaching "how to think," rather than "what to think," and with "learning how to learn." Adopted methodologies should incorporate those factors which enhance creative abilities while avoiding those which inhibit. Jerome Hausman, New York University educator, says, "The essential paradox is that of teaching within a tradition that requires expanding beyond that tradition."[9]

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[8]Marshall McLuhan, The Medium Is The Massage, N.Y. Bantam Books, 1967, p. 46.

[9]Jerome Hausman, "Research on Teaching the Visual Arts," Second Handbook of Research on Teaching, Chicago, Rand McNally, 1963, p. 1111.

ENHANCING FACTORS

Now we turn to a consideration of methods which support the nurturing of creative talent. Fourteen factors have been identified and are correlated with the performance objectives cited earlier.

PERFORMANCE OBJECTIVE ONE

At the conclusion of his or her studies, the medical illustrator will be able to demonstrate ability to conceptualize and visualize medical pictures, designs or diagrams.

METHODS

1. The teacher who expects students to conceptualize and visualize in a creative way, and who takes a problem-solving approach from the very beginning of a course, affects students' creativity positively. MacKinnon says:

> If our expectation is that a (student) of a given intelligence will not respond creatively to a task which confronts him, and especially if we make this expectation known to the (student), the probability that he will respond creatively is very much reduced. And later on such a (student) . . . may find doors closed to him so that he is definitely excluded from certain domains.[10]

Wilson, Robeck and Michael say:

> Students learn to be creative when their efforts toward unique production are recognized and reinforced.[11]

People will develop in ways that are rewarding to them, and if the teacher welcomes original ideas, the students will be more likely to produce unique

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[10]Donald W. MacKinnon, "The Nature and Nurture of Creative Talent," American Psychologist, Vol. 17, No. 7, July 1962, p. 493.

[11]John Wilson, Mildred Robeck and William Michael, Psychological Foundations of Teaching and Learning, McGraw-Hill Co., p. 100.

solutions. If a student is having difficulty with a problem, the student and teacher can assess the student's stage in the creative process. The instructor can ask a series of questions to get the student to think further. Thus the teacher does not solve the problem for the student, but encourages the problem-solving process.

2. Prejudging and criticizing ideas too soon stifles the production of creative concepts. The teacher can instill the attitude that it is better to try and fail than not to try. Many experiments have failed in the history of science, but scientists learn from mistakes and failures when results are studied. We note that Hans Krebs' teacher was self-critical, rather than being judgmental of his student. Warburg set an example, and Krebs became self-critical, also. In the preparation and incubation stages, the emphasis is on perceiving and conceptualizing rather than evaluating. MacKinnon writes:

> With reference to the attitudes of perceiving and judging, everyone must judge as well as perceive. It is not a matter of using one to the exclusion of the other, but a question of how each is used and which is preferred. The danger for one's creative potential is not the judging or evaluation of one's experience but that one pre-judges, thus excluding from perception large areas of experience. The danger in all parental instruction, as in all academic instruction, is that new ideas and new possibilities of action are criticized too soon and too often.[12]

When the teacher holds preconceived expectations of the ultimate product, and criticizes ideas too soon, the creative process is not facilitated.

3. Hurrying students on their projects may cause them to bypass important stages in the creative process: preparation, incubation,

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[12]Donald W. MacKinnon, "The Nature and Nurture of Creative Talent," American Psychologist, Vol. 17, No. 7, July 1962, p. 493.

illumination and elaboration. Valuing thinking and giving students time to think, will facilitate conceptualizing and visualizing. Teachers encourage creativity by recognizing and rewarding students when they think independently. Torrance says:

> One of the primary characteristics of the creative relationship as I conceive it, is the acceptance of thinking as a legitimate activity.[13]

4. Behavior modification theory suggests that positive reinforcement is effective for encouraging creative concepts. Science educators Arthur Carin and Robert Sund say:

> Give positive reinforcement for creative work. Never laugh at a student's ideas or conclusions. Compliment (students) for sincere guesses even when the guesses may be bizarre. Do not criticize answers to questions. Try not to use the phrase, 'That is wrong." Instead, respond positively by saying 'you are thinking and that is good, but you haven't quite discovered something else I can see.' Try to eliminate negative statements from your criticism. Use instead, 'That is good.' 'We are on the right track now.' 'That is a good idea.' 'Wonderful.' 'Great thinking.' Nothing pays like praise. Above all, respond to the students' answer: no reply is received as a negative response.[14]

PERFORMANCE OBJECTIVE TWO

The medical illustrator will be able to demonstrate ability to abstract the essence of complex information and present it in visual form.

METHODS

5. The teacher can encourage students to analyze and distill their ideas by getting the students to discuss their own work. Wilson, Robeck and

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[13] E. Paul Torrance, Guiding Creative Talent, N.J., Englewood Cliffs, Prentice Hall, 1962, p. 170.

[14] Arthur Carin and Robert Sund, Teaching Science Through Discovery, Columbus, Ohio, Charles E. Merril Publishing Co., 1964, pp. 135-136.

Michael say:

> The teacher's response to any production that is personal--that is to any work with which an individual identifies--is critical, particularly in the learning stages. Often the student's first attempts in a new mode of expression are his clumsiest, and the teacher may find it difficult to respond in supportive but meaningful ways. . . . Often the teacher can help students by encouraging them to discuss their own work. By expressing his ideas orally, the student can help the teacher make a more precise evaluation of his work; oral expression also encourages the student to develop his rudimentary ideas into complex expressions. When a mature adult considers the creative product seriously, the student senses that it is valued and therefore his own uniqueness is valued as well.[15]

6. The creative person is intuitive about experience. Teachers can facilitate this characteristic by stressing relationships and analogies among facts and theories. Emphasis on the transfer of training from one subject to another and searching for common principles and essential points encourages abstraction ability. MacKinnon says:

> . . . a seeking for symbolic equivalents of experience in the widest possible number of sensory and imaginal modalities, exercises in imaginative play, training in retreating from the facts in order to see them in larger perspective and in relation to more aspects of the larger context thus achieved . . . these . . . would strengthen the disposition to intuitive perception as well as intuitive thinking. . . . it is necessary that the student have a large body of facts which he has mastered . . . what I am proposing is not that in teaching one distain acute and accurate perception, but that one use it to build upon, leading the student always to an intuitive understanding of that which he experiences.[16]

Weisner says:

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[15]John Wilson, Mildred Robeck, and William Michael, Psychological Foundations of Teaching and Learning, McGraw Hill Book Co., 1969, p. 103.

[16]Donald MacKinnon, "The Nature and Nurture of Creative Talent," American Psychologist, Vol. [illegible], No. 7, July 1962, p. 493.

> Since logically interrelated bodies of factual material can be more efficiently scanned and searched, the accumulation of facts during training should stress principles, laws and structural relationships.[17]

Abstraction occurs during the incubation stage of the creative process, when all elements have been gathered and are sorted consciously and unconsciously.

PERFORMANCE OBJECTIVE THREE

The medical illustrator will be able to manifest flexibility and versatility in the aesthetic handling of varied media and production techniques.

METHODS

7. Educators Kenneth Beittel and Edward Mattil of Pennsylvania State University, found that the students who worked in a depth program produced paintings judged to have higher degrees of spontaneity and aesthetic quality than those students in a breadth-oriented program. Breadth teaching programs that shift quickly from media to media do not allow facility to develop, thus impeding the technical elaboration stage in the creative process.

> What this study suggests is that spontaneity is a product of both control and confidence and that such abilities and attitudes are more likely to develop in programs that provide for intensive work in a limited range of media than those that shift quickly from media to media. It is when skill is absent that confidence diminishes and tightness and rigidity enter.[18]

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[17] Jerome Weisner, "Education for Creativity in the Sciences," Daedalus, 1965, Vol. 94, No. 3, pp. 527-537.

[18] Kenneth R. Beittel and Edward L. Mattil, "The Effect of a 'Depth' versus a 'Breadth' Method of Art Instruction at the Ninth Grade Level," Studies in Art Education, 1961, 3, pp. 75-87.

8. The teacher can encourage inquisitiveness, curiosity and risk-taking for the exploration of alternatives. Inquisitiveness might appear to be impudence to a teacher, and it is important for the teacher to recognize the difference. Students sometimes have trouble saying what they really mean, and usually are not being impudent. The teacher can get the student to explain and articulate concepts. Torrance writes:

> Curiosity does not fare very well in our society. . . however. . . . It has been my observation that the curious person is never idle. The fact remains that in most classrooms the student runs a calculated risk every time he asks an unusual question or advances a new idea for fear of the ridicule by his classmates and perhaps his teacher. This risk is even greater in most adult groups . . . . Teachers in the relationships might do well to recognize this fact and try to free such individuals to ask questions and to explore a variety of alternate possibilities.[19]

9. Qualities intrinsic to the subject content can be used to promote interest and encourage mastery of technique, and flexibility and versatility. Medical subject matter itself is an exciting motivational device when the teacher makes a presentation of his knowledge of a particular organ or system. The anatomy of the eye, for instance, is beautiful and dramatic, and an illustrator's aesthetic viewpoint can be stressed in lecture discussion and slide presentations. A lesson in illustrating the external and internal eye could begin with a period devoted to teaching informative, factual information about the eye; this type of lesson plan serves a double purpose: to instruct and to motivat . The urge to draw and paint the beautiful or dramatic structures seen in the ophthalmoscope or in stereoptic slides will motivate the student to mastery of technique, and it will be enjoyable work, not

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[19]Paul Torrance, Guiding Creative Talent, New Jersey, Englewood Cliffs, Prentice Hall, 1962, p. 74.

drudgery, as may be the case when technique is separated from meaning.

Viktor Lowenfeld writes:

> A technique must be an integral part of the creative work. This means that a technique is never studied by itself, separate from the creative work. It must be a part of it. Its perfection grows through the urge for expression.[20]

The natural desire and need for technique arises when the individual is excited about elaborating and verifying the creative concept he has in mind. Any structure of the body could be approached in this way, with an emphasis on the aesthetic form, structure and function. Students want to acquire technique to execute their ideas when they are expected to solve artistic problems which are of interest to them. The artist's desire to capture a meaningful visualization is a strong motivation toward gaining technical expertise.

Devices which can be used in instructing and motivating consist of visual and audiovisual materials. University of Oregon educator Vincent Lanier, says, "The demonstration . . . permits the art teacher to make use of his art skill."[21] Lanier suggests other motivational devices also: films, slides, photographs and works of art themselves, either done by professional artists or students. In addition, the teacher can utilize verbal activities such as a talk given by a visiting artist, a discussion by members of the class, or brainstorming; exhibitions of student work; field trips to museums, galleries and studios. Lanier cautions:

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[20]Viktor Lowenfeld, Creative and Mental Growth, N.Y., The Macmillan Co., 1957, p. 47.

[21]Vincent Lanier, Teaching Secondary Art, Scranton, Pa., International Textbook Co., 1964, pp. 131-134.

> Good teaching involves knowing what constitutes undermotivation and overmotivation. To present a long series of devices focused on a particular process [i.e., technique] is to run the risk of tiring the class . . . . The best methodological advice that can be given is 'Teacher, know thy pupils.'[22]

10. The teacher can stress the ultimate use of a skill or product as a motivation toward mastery of technical skills. Flexibility and versatility result from mastery of technique. Lanier suggests:

> . . . stress on the ultimate use of the particular project. This type (of motivation) takes at least two forms: 1. the ultimate use of the product, and 2. the ultimate use of the skill or knowledge involved. Interest in a . . . project can be generated once students are convinced that they can transfer this ability from the classroom to their own uses.[23]

Learning that is based on a real need is significant. When a student engages in an assignment that fills a personally felt need, there is no feeling of superficiality. In medical illustration, working with a client may provide a strong motivation, and the student will desire to master skills in order to produce the product.

11. Professor Ann McGee says, "Freedom to play unlocks doors to discovery." Teachers should set limitations carefully to promote flexibility. MacKinnon explains:

> There is the openness of the creative person to experience both from within and from without which suggests that whether we be parent or teacher we should use caution in setting limits upon those whom we are nurturing experience and express . . . . Discipline and self control are necessary, they must be learned if one is ever to be truly

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[22] Ibid.

[23] Ibid.

> creative, but it is important that they not be over-learned. Furthermore, there is a time and place for their learning and having been learned, they should be used flexibly, not rigidly or compulsively.[24]

In medical illustration there are many opportunities for the teacher to expect original work, especially in surgical illustration, which is demanding and complex. Decisions about plane, point of view and level of focus are important elements in the composing and visualization of the illustration and the teacher can encourage the students to think flexibly about various alternatives and make their own decisions. Creative people are curious and enjoy difficult tasks, so limitations should be set cautiously. Learning does not take place readily in a chaotic or an authoritarian atmosphere.

PERFORMANCE OBJECTIVE FOUR

The medical illustrator will exhibit adaptability to change in the medical environment and the new communications technology.

METHODS

12. An open mind and the acceptance of change are attributes the teacher can exemplify. Students often identify with their teachers and model their behavior after the teachers'. Brewster Ghiselin says:

> Every new and good thing is liable to seem eccentric and perhaps dangerous at first glimpse, ... And therefore we must always listen to the voice of eccentricity within . . . the world. . . . we must expect to live . . . conscious of the imminence of change.[25]

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[24] Donald W. MacKinnon, "The Nature and Nurture of Creative Talent," American Psychologist, Vol. 17, #7, July 1962, p. 493.

[25] Brewster Ghiselin, The Creative Process, N.Y., Mentor Books, 1952, p. 31.

Art educators Frank Wachowiak and David Hodge, of The University of Georgia, suggest that successful art teachers are adaptable to change:

> The best instructors . . . experiment with and test new art materials. . . . keep in touch with the latest developments in education.[26]

13. The changing needs of medical education require that the illustrator be adaptable. In the past the bulk of the work was done for publication, but the uses for illustrations have expanded. An artist should be able to change "styles" when the need arises. The whole range of art modes are utilized, from the highly rendered realistic drawing through the stylized, simplified design to the abstract theoretical model of physiological functions or microscopic forms. The student must be able to suit the style of the illustration to the varied needs of the medical clientel. In the learning process there may be a place for copying the work or styles of master artists in order to gain flexibility and adaptability. Art educator Howard Conant says:

> Probably no art teacher would disclaim the many values inherent in aesthetically oriented creative art expression. This seems to be the form of art teaching most frequently practiced. Yet there are many art teachers who are unwilling to dismiss so obvious and important a human factor as the desire and occasional need to imitate. Such teachers know that children learn to speak, to read, to write and to do many other things by imitating others, and such practices have apparently not harmed subsequent creative expression in these fields. They also know that many distinguished artists throughout history have imitated their favorite masters. . . . It is likely that (these) teachers will let their best judgment be their guide.[27]

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[26] Frank Wachowiak, and David Hodge, Art in Depth, Scranton, Pa., International Textbooks, 1970, p. 13.

[27] Howard Conant, Art Education, Center for Applied Research in Education, Washington, D.C., 1964, pp. 35-36.

When the teacher uses many examples to illustrate styles and techniques, students learn that there are alternative approaches in medical illustration. The more different examples the student can see, the less likely he will copy one mode, but will develop his own personal styles. Max Broedel said, ". . . to imitate is relatively simple, but to create, much more difficult . . . ."[28] Wilson, Robeck and Michael comment:

> The imitator in art is downgraded, essentially because he allows himself to be controlled by the expression of another. The innovator is respected and appreciated because he assumes the responsibility of expressing the world from his own point of view. The imitator's work may be technically and aesthetically superior to that of the innovator, but it is not acclaimed by those who recognize the source of his inspiration. The process of imitating either others or oneself is crippling because the artist can no longer function at level 3 (creative self-direction) when he accepts from himself less than a new expression.[29]

14. The teacher who adjusts to varied conditions, who is not rigid and dogmatic, and who is enthusiastic about creating new ideas and products inspires students' creativity. When one continues to learn and adapt and change, one does not become dull and boring. Mattil recommends that the teacher:

> . . . be critical without being damaging, be selective without being biased, be able to direct without being dogmatic, be inspiring without establishing the ultimate goal, be patient without being indifferent, praise sincerely and freely without being indiscriminate . . . (the teacher) has the feeling he is on the right path, but when he is absolutely

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[28]Max Broedel, "Testimonial Dinner to H. A. Kelly," Bulletin of the Johns Hopkins Hospital, Vol. XIII, No. 2, Baltimore, The Johns Hopkins Press, 1933, p. 71.

[29]John Wilson, Mildred Robeck, William Michael, Psychological Foundations of Learning and Teaching, McGraw Hill, 1969, pp. 100-101.

> sure he is right about all of his teaching, he is in danger of becoming dull and dogmatic. H. L. Menchen once said, 'It is the dull man who is sure and the sure man who is dull.'[30]

INHIBITING FACTORS

Having covered methods advocated for the nurturing of creativity, we turn to our next concern. Unfortunately, there are some factors which inhibit creativity. The following are approaches to avoid.

1. A strategy of student powerlessness, in which the student is stripped of defenses, reduces intelligent action. Paul Torrance says this is done by making communication a one-way process in which the teacher adopts a position of omnipotence.

> In order to control students' behavior or to influence them to adopt certain behaviors . . . (teachers) may probe and insist that a student give reasons for everything he does or says. It may be done by an overconcern with his daydreaming, his feelings . . . (another technique) takes the form of threats of deprivation as a consequence of not adopting certain behaviors . . . a third procedure for making (students) feel powerless is to create as much uncertainty as possible . . . this is achieved by . . . irregular schedules, inconsistent discipline, withheld information about plans or decisions, no relaxation and true feelings kept hidden . . . . Withholding various types of information, including the results of tests . . . make it difficult for (the student) to know where he stands. The evidence is rather clear that all of these methods . . . can be shown to decrease creativity. Carl Rogers (1954) and others have cautioned against any condition that threatens the worth of the individual, and these techniques are calculated to do just that.[31]

2. When the teacher gives students very little time to think before answering questions, students interpret this to mean that their thinking is

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[30]Edward Mattil, Meaning In Crafts, N.J., Englewood Cliffs, Prentice Hall, 1971, p. 6.

[31]Paul Torrance, Guiding Creative Talent, Prentice Hall, p. 168.

not valued. Thinking is, of course, basic to creativity. Elliot Eisner, Stanford University Educator, reports:

> One of the few studies of teacher discourse in art was conducted by Robert Clements in 1964. He attempted to identify the types and patterns of questions teachers asked of their students when teaching art . . . . He found that . . . in the average 50-minute art lesson in which 59 questions were asked, a total of only 5 seconds of pausing were given. It was also found that . . . college teachers interrupted most frequently . . . . One of the striking findings of the study is that more than one-half of the answers were one second duration or less, and 90% were less than four seconds.[32]

3. Pressure to produce above a desired level has a deterring effect. Creativity was found to be lowered when 117 scientists and engineers were subjected to time pressures. University of Michigan Researchers Frank Andrews and George Farris found:

> . . . innovation and productivity were low if the pressure experienced was markedly above that desired . . .[33]

Pressure to cover large quantities of material in a short period does not allow time for creative thought processes. Wilson, Robeck and Michael say:

> It is relatively easy for an extremely efficient teacher to stifle creative learning merely by insisting on systematic learning of so much factual material that there is no time or energy left for anything else.[34]

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[32]Elliot Eisner, "Research on Teaching the Visual Arts," Second Handbook of Research on Teaching, Rand McNally, 1973, p. 1207.

[33]Frank M. Andrews and George F. Farris, "Time Pressure and Performance of Scientists and Engineers: A Five Year Panel Study," Organizational Behavior and Human Performance, 1972, Oct., Vol. 8(2), pp. 185-200.

[34]John Wilson, Mildred Robeck and William Michael, Psychological Foundations of Teaching and Learning, McGraw Hall Book Co., 1969, p. 100.

4. A fear of error or disapproval is inhibiting to creative thought. Jerome Kagan, Harvard Professor of Developmental Psychology, says:

> The freedom that permits 'generation of possibilities' . . . is the beginning of a creative product. The enemy of this fluid process is a severe attitude toward error. The fear of being incorrect which represents the fear of disapproval by the social community, acts as a permanent insulation against the discovery of new mental combinations.[35]

Toffler adds:

> Let us not fear occasional error--the imagination is only free when fear of error is temporarily laid aside.[36]

6. The unfriendly environment restricts healthy creative growth. Torrance has studied "brain washing" techniques and concludes:

> The strategy of the totally unfriendly environment as used by a coercive agent requires that no one show friendliness or sympathy . . . . Teachers are likely almost never to employ this technique . . . but, because of their own psychological needs many teachers may avoid giving any evidence of affect or human feeling. They are afraid they will become too involved in the problems of their students . . . consequently they present themselves as cold, objective and unfeeling. This may be damaging in working with sensitive, highly creative individuals.[37]

6. The authoritarian environment discourages creativity. It is known that progress in science requires an appropriate environment. The major environmental factor is that of academic freedom. Wilson, Robeck and Michael say that the dogmatic approach restricts individual initiative.

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[35]Jerome Kagan, Creativity and Learning, Boston, Beacon Press, 1967, p. x.

[36]Alvin Toffler, Future Shock, N.Y. Bantam Books, 1970, p. 188.

[37]E. Paul Torrance, Guiding Creative Talent, N.J. Englewood Cliff, Prentice Hall, 1962, p. 182.

> Many home, school and work environments actively discourage the individual from assuming initiative. The insistence that father and mother (or the teacher) know best, that deviation from their pattern constitutes disobedience, actively discourages development of the freedom essential to creativity. The school in which the answers, methods and programs are fully organized into a closed system has a similar restrictive effect on creative self-direction. Work environments that are highly structured for efficient production pay a price for produtivity by delimiting initiative and innovation. . . . Only the very strong, in such circumstances, are comfortable as they assert their independence and assume responsibility for creating . . . [38]

7. Regulation and orderliness when rigidly used are inhibiting and the teacher who is compulsive about teamwork, togetherness and conformity discourages independent thought and work. Jerome Kagan says:

> To teach the (student) to generate possibilities in the face of a problem and to reduce his anxiety over expressing actions that do not match those of the majority are difficult but central missions of education. The decades of the forties and fifties witnessed a zealous concern with group adjustment, an evangelical fervor to bring the child on the sidelines to the center. The lack of tolerance for heterogeniety quickly cripples the generative process and the sculpting of creative (individuals).[39]

Doris Trojcak, Science Educator asks:

> How tolerant and flexible are you? Must assignments look like they have come off an assembly line, even an uncoordinated assembly line? . . . Too many clues or too much teacher intervention will stifle the creative process.[40]

8. Incessant petty distractions thwart creativity. If creative

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[38] John Wilson, Mildred Robeck and William Michael, Psychological Foundations of Teaching and Learning, McGraw Hill Book Co., 1969, p. 100.

[39] Jerome Kagan, Creativity and Learning, Boston, Beacon Press, 1967, pp. x-xi.

[40] Doris A. Trojcak, "Teaching/Learning Strategies in the Basic Subjects: Science," Instructor, April 1975, p. 59.

people are given blocks of time unhindered by distractions, productivity is raised, according to Philip Abelson, Director of the Geophysical Laboratory at the Carnegie Institution of Washington:

> In our efforts at organizing research we probably make our greatest mistakes in failing to provide for the need for total immersion in creative thought. In choosing leaders . . . and others higher up on the administrative ladder, we select men who have demonstrated ability as creative scientists. We then saddle them with the need to make a continuing series of major and minor decisions, and provide them with an ever-ringing telephone. . . . In the process we destroy most of their potentiality for creativity . . . I would suggest the research administration be organized so that all creative individuals have frequent opportunities to attain total immersion in technical problems. Administrative responsibilites, if they have them, should be attended to periodically, but with free spaces in between.[41]

SUMMARY

The teacher is important in encouraging creative achievement by students. Because of the nature of medical illustration, the teacher can actively involve students in conceptualizing, visualizing and abstracting information. Because the field itself has changed, characteristics of adaptability, flexibility and versatility are in demand. The teacher can design instruction which encourages these traits.

Methods which have been found to enhance creativity are summarized here. Creative abilities are nurtured when the teacher:

1. Adopts a problem-solving approach
2. Avoids premature judgment of students' ideas
3. Accepts thinking as a legitimate activity

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[41] Philip H. Abelson, "Relation of Group Activity to Creativity in Science," Daedalus, Vol. 94, #3, 1965, pp. 613-614.

4. Utilizes positive reinforcement
5. Encourages students to discuss their own work
6. Stresses principles and relationships among facts
7. Adopts a depth-oriented program
8. Encourages curiosity
9. Utilizes effective motivational devices
10. Stresses the ultimate use of a skill or product
11. Sets limitations cautiously
12. Exhibits acceptance of change
13. Utilizes many examples
14. Continues to learn.

Creativity is inhibited when the teacher:

1. Adopts a strategy of student powerlessness
2. Allows little time to think
3. Exerts pressure--holds rigid course coverage expectations
4. Holds an attitude of intolerance toward error
5. Maintains an unfriendly environment
6. Adopts a dogmatic, authoritarian approach
7. Expects togetherness and conformity
8. Fails to provide time for total immersion in creative work.

This list of teaching methods can serve as an outline for medical art educators in promoting creativity in their students.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

This study attempts to aid the teacher of medical illustration in promoting in students an active, imaginative and lively use of their creative resources. The objective has been to identify sources and interpret findings from the following fields: medical illustration, psychology and education. The need for this study, background information, limitations and procedure were discussed in Chapter I.

Chapter II reviewed the treatment of creativity in the literature of medical illustration, examined the literature on creativity by psychologists and other behavioral scientists, and discussed readings on educators' teaching methods.

Creativity has always been valued in graduate education in that original research and contributions to knowledge are stressed. There has been in the past, however, a failure to interface between the areas of educational psychology and science and art in institutions of higher learning. We are seeing the implications of research in creativity and can now adapt this knowledge to teaching.

Chapter III established the medical illustrator's need for creative ability, and derived performance objectives based on the literature. The four objectives are condensed here: the professional medical illustrator will demonstrate conceptualization, visualization and abstraction abilities,

and will exhibit characteristics of flexibility and versatility in art techniques and adaptability to change in the medical environment.

Chapter IV asked, "What is creativity?", and discussed definitions of the term from several perspectives: (a) process, (b) product, and (c) experience. Chapter IV also dealt with the steps in the creative process. In reviewing this chapter we see that creativity is evidenced by the ability to relate things that have previously been treated separately; in other words, synthesizing ability. The invention of medical teaching materials requires the artist to go beyond mere recall of information: interpret, conceptualize and synthesize. This is accomplished through the steps of the creative process: first, the desire to solve a problem arises; next, study, analysis and trial and error take place for the formation of a concept or mental picture; after a time of incubation, the flash of insight ("A-ha!") occurs; and last comes the psychomotor labor of testing and revising, rendering and refining the product.

Chapter V, the most important section, dealt with educational methodologies for fostering creativity. The importance of the teacher's role was stressed. The nurturing of creative talent was elaborated through fourteen enhancing factors which were identified and correlated with the performance objectives cited earlier. Eight inhibiting factors were also discussed. The enhancing methods listed have been found to improve the creativity of children, high school and college students and professionals.

This writer suggests that teachers try the methods which are discussed in Chapter V. These are reviewed here. The teacher:

1. Adopts a problem-solving approach

2. Avoids premature judgment of students' ideas
3. Accepts thinking as a legitimate activity
4. Utilizes positive reinforcement
5. Encourages students to discuss their own work
6. Stresses principles and relationships among facts
7. Adopts a depth-oriented program
8. Encourages curiosity
9. Utilizes effective motivational devices
10. Stresses the ultimate use of a skill or product
11. Sets limitations cautiously
12. Exhibits acceptance of change
13. Utilizes many examples
14. Continues to learn

Many people have seen medical illustration in a narrow role, as simply accurately reproducing the appearance of an anatomical specimen. However, the literature recognizes the importance of creativity. Highly respected medical illustrators such as Max Broedel, Robert Demarest, and Frank Armitage support the need for creative abilities in medical art.

The abilities to conceptualize, to visualize, to abstract, and to exhibit flexibility, versatility and adaptability can be consistently nurtured only when educational programs for medical illustrators are designed in such a way that creativity is fostered throughout the program. Perhaps one of the problems is that, as has been said, "We teach as we have been taught."

The needs of the present and future suggest that there is a gap between theory and practice. This writer recommends:

A. That the gap be filled with development of a series of lesson plans for teachers of medical illustration based on the research presented here.

B. That teaching workshops be held at each training institution to discuss the implications and to brainstorm for problem-solving approaches to teaching medical illustragion.

The visible and hidden forms and functions of that "incredible machine," the human body, are subtle and complex, and provide a universe of subject matter for the medical illustrator.

Teachers can assist their students to a satisfying and creative career in medical illustration. A wider understanding of the intellectual processes of creation, and an understanding of the environmental factors affecting creative work will enable professors and students to be original in their research and to make contributions to knowledge.

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